

### Accretion and Bipolar Outflow in Sanduleak's Star

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Sanduleak's star is a suspected symbiotic binary located in the Large Magellanic Cloud. It is known that it has a giant jet with physical size  $\sim 14$ pc. Its spectrum shows two strong emission bands at 6825Å and 7082Å, which are originated from Raman-scattering of O VI by neutral hydrogen atoms. We present the high-resolution spectrum of Sanduleak's star obtained with MIKE at the Magellan-Caly telescope to investigate the O VI emission region based on the profiles of the two Raman features. In this spectrum, it is noted that the Raman 6825Å feature exhibits a single broad peak profile, which is in high contrast with a clear triple peak profile of the Raman 7082Å feature. In our analysis we suggest that the O VI emission region consist of three main emission parts: an accretion disk, a bipolar outflow and an optically thick, compact component surrounding the white dwarf. By performing Monte Carlo simulation we constrain the representative column density of the H I scattering region  $N_{\text{HI}} \sim 1 \times 10^{23} \text{ cm}^{-2}$ , which is in accordance with the observed flux ratio in the two Raman features  $F(6825)/F(7082) \sim 4.5$ .

### [포 ST-02] Formation of short-period black hole binary systems from Population III stars as gravitational wave radiation sources

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Massive Population III black hole binary systems are one of the suggested candidate sources of the recently detected gravitational wave radiation (GWR). GWR detection from a black hole binary system requires a sufficiently short orbital separation at the time of their formation, such that they would undergo coalescence within the Hubble time. This condition cannot be simply fulfilled by a short initial period, because binary interactions such as mass transfer and common envelope evolution can largely change the orbital

parameters and the masses of stellar components. Here, we discuss the possibility of black hole binary mergers from massive Pop III binary systems, using a new grid of Pop III binary evolutionary models with various initial primary masses ( $20 M_{\odot} \leq M \leq 100 M_{\odot}$ ) and initial separations, for different initial mass ratios ( $q = 0.5 - 0.9$ ).

### [포 ST-03] Photometric Observations for $\delta$ Sct and SX Phe Variables

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변광성은 거리를 결정하기 위한 중요한 천체이며, 대표적으로 RR Lyr형 변광성을 사용하여 성단까지의 거리를 결정해왔다. 하지만 성단의 거리를 결정함에 있어 성단 구성원의 multi-population을 고려해야 한다는 의견이 최근 제시되어 왔으며, 이를 위해 RR Lyr형 외에 새로운 지표가 필요한 실정이다. 변광성 중에서  $\delta$  Sct와 SX Phe형의 경우 짧은 변광 주기를 가지기 때문에, RR Lyr형을 대신할 새로운 지표로 대두되고 있다. 따라서 본 연구에서는 국립고흥청소년우주체험센터(NYSC)에서 주최하는 천문실습 과정에 참여하여 각각 2개의  $\delta$  Sct와 SX Phe형 변광성을 NYSC 1m 망원경을 사용하여 관측하였다. 실습과정에서 진행된 관측 및 자료처리 과정에 대한 검증을 위해, 관측 대상의 광도곡선을 얻고 문헌의 결과와 비교하고자 한다.